DISCUSSION

Intro paragraph summarising the results as they respond to the hypotheses we started out with.

Which of the hydrological metrics actually reflect hydrological heterogeneity?

* Need to check out how I’ve introduced the hydro metrics in the methods

Species richness was affected by homogenising disturbance but not FDis or FRic

What do FDis.SES (functional divergence) and FRic.SES (?) actually mean, and what are the implications of the patterns we found for community assembly?

Fairly low % variance explained by FRic (although better by FDis), esp compared with Lawson et al. study (hydrology explained 80% of FDis). Undescribed environmental conditions, neutral processes, and small scale land management practices control the rest of community assembly.. (if you stay within environmental niche ecology). phylogenetic conservation of traits is another possibility but we didn’t test it (?)

* Are different processes at play here? Diversity driven by consistent patterns of resource availability (in this study – is that quite what happened with the Colwell’s indices?) (Lundholm 2009 found that energy availability was much better predictor of spp. richness than env. Var) vs diversity as driven by environmental variability in previous study…
* Jardine et al. said environmental filtering (well, niche optimisation) is only relevant in rhythmic rivers and that communities in arrhythmic should be structured by neutral processes but I don’t agree. Environmental filtering for conservative strategies has been shown in arrhythmic environments. In any case they measured NPP rather than diversity but the two things are interrelated.
* Mouillot et al 2013 suggested that environmental filtering would compress traitspace as disturbance increases.

What about resilience and ecosystem functioning, can I say anything about that? I can refer back to my info about effect traits and their relationships with ecosystem functioning. FD & ecosystem multifunctionality

Interactions between env variables?

Belowground traits, categorical data types that allow multiple category membership

What are the implications for conservation?

NOTES on RESULTS:

**Species richness:**

Richness highest along rivers which experience regular seasonal patterns of low flows. What’s more, increasing species richness is also associated with increasing flow modification – where the effect of the modification is to increase seasonal regularity of low flows. Richness decreased with high spell mean duration (makes sense if long flood duratons are an environmental filter selecting for inundation tolerance more than a form of ‘heterogenising disturbance’) but also decreased with variability in HSMeanDur – perhaps indicating an influence of extreme events (i.e. the odd 10 day inundation wipes out a bunch of species from the pool – maybe doesn’t make a huge amount of sense given high immigration rates in riparian environments – unless the landscape is highly fragmented…). Land use also didn’t decrease species richness – only ‘significant’ relationship was with dryland land use and was unimodal. All other relationships were monotonic.

So in conclusion – no real support for hyp1 that flow mod and land use should decrease spp. richness, or hyp2a, that rivers with more variable flow regimes host communities with higher species richness, or hyp2b, that there is a unimodal relationship between heterogeneity and spp. richness.

**Exotic abundance**

Hyp1 was that exotics should increase with land use intensity and flow modification. Didn’t detect any effect of flow modification but production land uses were associated with higher exotic abundance. WRT hyp 2, we found the opposite of expected: hydrological heterogeneity (as measured by CVAnnBFI, CVMDFDry and CVAnnHSMeanDur) appears to be associated with higher exotic abundance.

The rationale for our hypothesis was that or hydrological heterogeneity should result in structural complexity of habitat and therefore limit competitive exclusion by invasives. A contrasting explanation for the observed relationships reads as follows: disturbance associated with heterogeneous flows opens habitat up for exotics spp. with acquisitive / ruderal / pioneer life history strategies, however. Important to note the temporal sequence inherent in response to disturbance regimes: it is important when the communities were sampled, in terms of the amount of time elapsed since the last flood. Should be plenty of literature about disturbance / environmental variability and invasion…

**Functional richness**

So what this actually is is not convex hull volume, but the ratio of observed convex hull volume to average convex hull volume for the number of species in the assemblage.

No effect of either land use or flow modification on functional richness (hyp1) (except perhaps a v weak relationship with MDFMDFDry.mod). Hydrology was important although most variation explained by hydrology was shared with climatic and soil conditions. Some evidence to support Hyp2b (delta AIC = 3.70146 for CVAnnBFI and 1.36936 for HSMeanDur).

Interesting that sp richness increases with soil\_soc but FRic decreases. Seems to indicate that that niches are getting closer together in traitspace, although the effect could be stochastic given that we don’t have that much data in the upper reaches of the gradient (actually I was looking at the FDis.SES graph.)

**Functional dispersion**

No effect of land use or flow mod. (except again a possible weak relationship with MDFMDFDry.mod). Hydrology does explain some variation in FDis, although not independently from soil conditions. FDis showed a unimodal relationship with seasonality of max flows (supporting hyp 2, delta AIC = 10.0751).

So the environmental conditions we tested in this study really didn’t explain all that much of functional diversity.

Mouillot et al 2011 functional structure ecosystem multifunctionality



The third facet of functional diversity, functional divergence, was introduced to quantify whether higher abundances are close to the volume borders (Figure 1 [3 and 3']). The corresponding index, proposed by Villéger et al. (2008), is named FDiv and ranges between 0 and 1. This index approaches zero when highly abundant species are very close to the centre of gravity of the volume occupied and it approaches unity when highly abundant species are very distant from the centre of gravity.

Mouillot et al 2013 – disturbance

Most exciting of all, analyses of functional traits offer

the potential for advanced warning [62] because they can detect disturbance impacts before species loss and extinc- tions occur (Box 3). Indeed, species abundance distribu- tions are expected to be modified deterministically in the functional space after disturbance, with species having combinations of traits under pressure losing abundance, whereas the others may remain stable. Given that these abundance changes will occur before local extinctions, reductions in functional divergence and evenness, which both reflect abundance distributions in the functional space, will reveal disturbance impacts earlier than will functional richness (Box 3, Figure I).

Mouchet 2010

Functional divergence – “species deviance from the mean distance to the centre of gravity weighted by relative abundance”